

I CLAIM:

1. A tungsten-containing firearm projectile, comprising:
a body at least substantially comprised of a composition of matter that includes at least a tungsten-containing component and at least one binder, wherein the body has a density of at least 8 g/cc, and further wherein the composition of matter has an extrusion constant (k) of less than 30,000 pounds per square inch (psi), with the extrusion constant being defined by the equation $P = k \ln (A/A')$, with (P) representing the extrusion pressure in psi, (A) representing the cross-sectional area of a sample formed from the composition of matter before extrusion and (A') representing the cross-sectional area of the sample after extrusion.
2. The projectile of claim 1, wherein the composition of matter has an extrusion constant that is less than 20,000 psi.
3. The projectile of claim 1, wherein the composition of matter has an extrusion constant that is within 10% of the extrusion constant of a lead sample having the same cross-sectional areas as the sample before and after extrusion.
4. The projectile of claim 1, wherein the composition of matter has an ASTM Hall flowmeter reading of less than 18 seconds for fifty grams of the composition of matter passing through a cone without tapping.

5. The projectile of claim 4, wherein the composition of matter has an ASTM Hall flowmeter reading of less than 14 seconds for fifty grams of the composition of matter passing through a cone without tapping.

6. The projectile of claim 1, wherein the tungsten-containing component includes ferrotungsten.

7. The projectile of claim 1, wherein the tungsten-containing component includes an alloy of tungsten, nickel and iron.

8. The projectile of claim 1, wherein the composition of matter includes tin.

9. The projectile of claim 1, wherein the at least one binder includes at least one metallic binder.

10. The projectile of claim 1, wherein the at least one binder includes at least one non-metallic binder.

11. The projectile of claim 10, wherein the at least one binder further includes at least one metallic binder.

12. The projectile of claim 11, wherein the at least one metallic binder includes tin and the at least one non-metallic binder includes a thermoset resin.

13. The projectile of claim 1, wherein the body is at least substantially formed from a compressed powder of the composition of matter.

14. The projectile of claim 1, wherein the body is frangible.

15. The projectile of claim 1, wherein the body has a density of at least 10 g/cc.

16. The projectile of claim 15, wherein the body has a density in the range of 10.5 g/cc and 12 g/cc.

17. The projectile of claim 1, further comprising a coating on the body.

18. The projectile of claim 17, wherein the coating includes a polymeric coating.

19. The projectile of claim 1, further comprising a metallic jacket that at least partially encloses the body.

20. A firearm cartridge containing a firearm projectile according to claim 1.

21. A tungsten-containing firearm projectile, comprising:

a frangible, lead-free body at least substantially comprised of a compacted powder comprising at least a tungsten-containing component and a tin-containing component, wherein the body has a density in the range of 10 g/cc and 13 g/cc, and further wherein the compacted powder has an extrusion constant (k) of less than 30,000 pounds per square inch (psi), with the extrusion constant being defined by the equation $P = k \ln (A/A')$, with (P) representing the extrusion pressure in psi, (A) representing the cross-sectional area of a sample formed from the compacted powder before extrusion and (A') representing the cross-sectional area of the sample after extrusion.

22. The projectile of claim 21, wherein before compaction, the powder has an ASTM Hall flowmeter reading of less than 18 seconds for fifty grams of the powder flowing through a cone without tapping.

23. The projectile of claim 22, wherein before compaction, the powder has an ASTM Hall flowmeter reading of less than 16 seconds for fifty grams of the powder flowing through a cone without tapping.

24. The projectile of claim 22, wherein the compacted powder has an extrusion constant of less than 20,000 psi.

25. The projectile of claim 21, wherein the tin-containing component is at least substantially comprised of tin.

26. The projectile of claim 21, wherein the tungsten-containing component includes ferrotungsten.

27. The projectile of claim 21, wherein the tungsten-containing component includes an alloy of tungsten, nickel and iron.

28. The projectile of claim 21, wherein the body is unsintered.

29. The projectile of claim 21, wherein the powder further comprises at least one non-metallic binder.

30. The projectile of claim 29, wherein the at least one non-metallic binder includes a thermoset resin.

31. The projectile of claim 30, wherein the at least one non-metallic binder includes a flexible epoxy.

32. The projectile of claim 30, wherein the projectile further comprises a non-metallic coating on the body.

33. The projectile of claim 32, wherein the projectile further comprises a jacket that at least substantially encloses the body.

34. A firearm cartridge containing a firearm projectile according to claim 21.

35. A method for forming a tungsten-containing firearm projectile, the method comprising:

compacting a mixture comprising a tungsten-containing powder and at least one binder under a first pressure to yield an intermediate structure, wherein the mixture has an ASTM Hall flowmeter reading of less than 18 seconds for fifty grams of the mixture flowing through a cone without tapping; and

reshaping the structure by applying a second pressure that is lower than the first pressure to yield a tungsten-containing firearm projectile having a different shape than the intermediate structure and a density of at least 10 g/cc.

36. The method of claim 35, wherein the mixture has an extrusion constant (k) of less than 30,000 pounds per square inch (psi), with the extrusion constant being defined by the equation $P = k \ln (A/A')$, with (P) representing the extrusion pressure in psi, (A) representing the cross-sectional area of a sample formed from the mixture before extrusion and (A') representing the cross-sectional area of the sample after extrusion.

37. The method of claim 35, wherein the intermediate structure and the firearm projectile have densities that differ by no more than 1 g/cc.

38. The method of claim 35, wherein the firearm projectile is longer than the intermediate structure.

39. The method of claim 35, wherein the method further comprises applying a non-metallic sealant to the intermediate structure before the reshaping step.

40. The method of claim 35, wherein the compacting step includes compressing the mixture in a die with a compaction punch assembly that includes at least one punch having a mixture-compressing face adapted to compress the mixture to form the intermediate structure, wherein the reshaping step includes compressing the intermediate structure with a die with a reshaping punch assembly that includes at least one punch having a structure-compressing face adapted to engage the structure as the structure is compressed to form the firearm projectile, and further wherein the mixture-compressing face and the structure-compressing face have different shapes.

41. The method of claim 40, wherein at least one of the compaction punch assemblies includes a mixture-compressing face with an outer perimeter, a shoulder that extends inward from the outer perimeter, and at least one of a depression and a projection internal of the shoulder.

42. The method of claim 35, wherein the tungsten-containing powder comprises at least one of ferrotungsten powder and an alloy of tungsten, nickel, and iron.

43. The method of claim 35, wherein the mixture further comprises tin.

44. The method of claim 35, wherein the binder includes at least one metallic binder component and at least one polymeric binder component.

45. The method of claim 35, wherein the method further comprises applying at least one of a sealant, a coating and a jacket to the intermediate structure prior to forming the projectile from the intermediate structure.

46. The method of claim 35, further comprising heating the intermediate structure during formation of the projectile.

47. The method of claim 46, wherein the heating step heats, but does not sinter, the intermediate structure or the projectile.